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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
VAN ROY, TOD THOMAS	
ART UNIT	**PAPER NUMBER**
2828	

DATE MAILED: 01/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/695,583	CAPRARA ET AL.
	Examiner	Art Unit
	Tod T. Van Roy	2828

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *45-68,70-74 and 77-86* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *45-68,70-74 and 77-86* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *10/28/2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

The examiner acknowledges the amending of claims 53, 56, 59, 61, 64-65, 70, 73, 77, as well as the cancellation of claims 69, and 75-76.

The examiner also acknowledges the amending of the specification, and accordingly withdraws the objection to the figures.

Response to Arguments

Applicant's arguments filed 11/21/2005 have been fully considered but they are not persuasive.

With respect to claims 45-52 and 73-74, the applicant has stated that Rosiewicz has taught a fundamental output power of 600mW, while Alford's system, including the optical crystal, has an output power of 5mW. The examiner agrees with the applicant that this is the case, however, it is not evident that the addition of only the crystal from Alford's system would drop the output power of Rosiewicz below 100mW. The 5mW output from Alford is not due solely to the crystal, but from the system in its entirety. The primary reference of Rosiewicz teaches all of the claimed subject matter except for the crystal, and that element is what is accordingly motivated in the rejection to the claim. It is not believed that simply adding the crystal to Rosiewicz's system would significantly alter the output power from the level claimed.

With respect to claims 77-86, the applicant has stated that it would be non-obvious to use a non-linear crystal in a separate branch of the resonator due to work that was currently being done at the time of the invention (1999). The examiner does

not agree that placing the crystal in a separate branch is non-obvious as the applied reference of Liu was published in 1977. The examiner admits that this system is not an OPS structure, but is teaching fundamental principles of laser resonators and the use of frequency changing crystals in those resonators. For this reason, it is believed that the use of the reference is proper and that motivation for the combination of the references exists.

Applicant's arguments with respect to claims 59-60, 70-72, and 61-68 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's arguments, see Remarks, filed 11/21/2005, with respect to the rejection(s) of claim(s) 53-58 under USC 102 and 103 have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 45-47, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz et al. (A. Rosiewicz et al., "Optical pumping improves VCSEL performance" Laser Focus World. June, 1997, pp. 133-136) in view of Alford et al. (W.J. Alford et al., Intracavity frequency doubling of an optically-pumped, external-cavity surface-emitting semiconductor laser, " Advanced Solid State Laser Conference, Sandia National Laboratories, SAND-98-21 08C CONF-990105 December 3 l, 1998).

With respect to claim 45, Rosiewicz teaches a laser comprising: a laser-resonator including an output coupling mirror (fig.1); an Ops structure having a surface-emitting gain-structure (fig.1 right side), said gain-structure including a plurality of active layers having separator layers therebetween said active layers having a composition selected to provide emission of electromagnetic radiation at a fundamental wavelength within a gain bandwidth of said gain-structure (pg.1 col.1 para.3), when optical-pump light is incident on said gain-structure; said OPS structure being supported on a substrate located outside said laser-resonator with said gain-structure of said Ops-structure being inside said laser resonator (fig.1, DBR above substrate in resonator, pg.1 col.1 para.3), a heat-sink arrangement for cooling said Ops-structure (fig.1 heat

sink); and an optical arrangement for delivering said pump-light to said gain-structure (fig.1 pump and optics), thereby causing fundamental laser-radiation having said fundamental-wavelength to oscillate in said laser-resonator; and radiation exiting the cavity through the output coupling mirror is greater than about 100 mw (pg.3 col.1 para.3, >600mw). Rosiewicz does not teach an optically nonlinear crystal located in said laser-resonator and arranged for frequency-doubling said fundamental laser-radiation thereby providing frequency-doubled radiation having a wavelength half of said fundamental-wavelength. Alford teaches an OPS pumping structure containing a frequency doubling crystal (fig.1). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz with the nonlinear crystal of Alford in order to shift the output frequency and obtain a new wavelength usable in applications such as displays, and data storage (Alford, pg.2 col.1 para.1).

With respect to claim 46, Rosiewicz and Alford teach the OPS structure as outlined in the rejection to claim 45, and Rosiewicz further teaches the pump angle to be non-normal (fig.1).

With respect to claim 47, Rosiewicz and Alford teach the OPS structure as outlined in the rejection to claim 45, and Rosiewicz further teaches the output coupler to have a concave surface (fig.1, concave external mirror).

With respect to claim 52, Rosiewicz and Alford teach the OPS structure as outlined in the rejection to claim 45, and Rosiewicz further teaches the OPS structure to

contain a mirror structure surmounted by a gain structure and the mirror structure is the first mirror (fig.1 DBR).

Claims 48-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Alford, and further in view of Selker et al. (US 5485482).

With respect to claims 48-49, Rosiewicz and Alford teach the OPS structure as outlined in the rejection to claim 45, but do not teach the mode quality to be about 1.2. Selker teaches a diode pumped laser wherein the mode quality is taught to be about 1.2 (col.4 lines 49-50, 1.1). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz and Alford with the mode quality of Selker to minimize beam divergence and improve coupling of the radiation to optics, as well as reduce system losses.

Claims 50-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Alford, and further in view of Tsunekane (US 5870415).

With respect to claims 50-51, Rosiewicz and Alford teach the OPS structure as outlined in the rejection to claim 45, but do not teach a birefringent filter to be located within the resonator. Tsunekane teaches a folded cavity, pumped, 2nd harmonic system wherein a birefringent filter is formed (col.1 lines 66-67). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz and Alford with the filter of Tsunekane in order to closely select a desired

oscillation bandwidth, and suppress noise generation within the system (Tsunekane, col.2 lines 4-10).

Claim 59 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz.

With respect to claim 59, Rosiewicz teaches a laser comprising: a laser-resonator formed by at least two mirrors (fig.1 external, DBR); an Ops-structure having a surface-emitting gain-structure (fig.1), said gain-structure including a plurality of active layers having separator layers therebetween said active layers having a composition selected to provide emission of electromagnetic radiation at a predetermined fundamental-wavelength when optical-pump light is incident on said gain-structure (pg.1 col.1 para.3); said laser-resonator configured to include said gain-structure of said OPS-structure (fig.1 gain structure in resonator since DBR is underneath); an optical arrangement for delivering said pump-light to said gain-structure (fig.1 pump and optics), thereby causing fundamental laser-radiation having said fundamental-wavelength to circulate in said laser-resonator; a heat-sink arrangement for cooling said Ops-structure and said laser-resonator (fig.1 heat sink), said Ops-structure, said heat-sink arrangement and said optical pump-light-delivering arrangement selected and arranged such that said resonator delivers output-radiation having said fundamental-wavelength. Rosiewicz does not teach the fundamental wavelength to be emitted at a power greater than 2 W. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the single OPS structure of Rosiewicz with the 2W

output power as a matter of operational design choice to achieve high output powers usable in a multitude of industrial applications such as cutting or welding.

Claim 60 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu (US 4048515).

With respect to claim 60, Rosiewicz teaches the OPS structure as outlined in the rejection to claim 59, but does not teach the resonator to be formed from 3 mirrors. Liu teaches a 3 mirrored laser resonator which utilizes an optical crystal to frequency double the output (abs., fig.1). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the system of Rosiewicz with the extra mirror and crystal of Liu in order to frequency double the output radiation and make use of wavelengths not previously attainable from the given active region.

Claims 53, 58, 70-71 are rejected under 35 U.S.C. 103(a) as being unpatentable Alford.

With respect to claim 53, Alford discloses a laser comprising: a laser-resonator having a resonator axis and being terminated by first (fig.1 DBR) and second mirrors (fig.1 HR coated side); an Ops-structure having a surface-emitting gain-structure (fig.1), said gain-structure including a plurality of active layers having separator layers therebetween, said composition selected to provide emission of electromagnetic radiation at a fundamental wavelength within a gain bandwidth of said gain-structure characteristic of said composition (pg.4 col.2 1st para.), when optical-pump light is

incident on said gain-structure; said OPS structure being supported on a substrate located outside said laser-resonator with said gain-structure of said Ops-structure being inside said laser resonator (fig.1, sub under DBR mirror, outside resonator); an optical arrangement for delivering said pump-light to said gain-structure (fig.1 pump arranged at bottom, non-normal), thereby causing fundamental laser-radiation having said fundamental-wavelength to oscillate in said laser-resonator, and wherein one of said first and second mirrors is partially transmissive for delivering said laser radiation from said laser resonator (fig.1 HR mirror acts as output for 2nd harmonic). Alford does not teach said active layers to have a composition Inx Gal-x N where 0.0 <x<1.0. It would have been obvious to one having ordinary skill in the art at the time the invention was made to make the laser of these known materials, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960).

With respect to claim 58, Alford discloses the mirror structure surmounted by said gain structure is the first mirror (fig.1, DBR mirror on left).

With respect to claim 70, Alford teaches a method of irradiating a material for cutting, ablating, heating, or photochemically altering the material (pg.3 col.1 para.1, data storage writing) comprising: providing an OPS laser (outlined in the rejection to claim 53), and delivering the radiation to the material (inherent in performing the operations in pg.3 col.1 para.1). Alford does not teach the output power to be greater than 2W. It would have been obvious to one of ordinary skill in the art at the time of the

invention to combine the single OPS structure of Alford with the 2W output power as a matter of operational design choice to achieve high output powers usable in a multitude of industrial applications such as cutting or welding.

With respect to claim 71, Alford teaches the method of claim 70, and further teaches the output radiation to be delivered by a light guide (fig.1, index difference between output mirror and air would constitute a light guide to deliver light to the target).

Claims 54-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Selker.

With respect to claims 54-55, Alford teaches the OPS structure as outlined in the rejection to claim 53, but does not teach the mode quality to be about 1.2. Selker teaches a diode pumped laser wherein the mode quality is taught to be about 1.2 (col.4 lines 49-50, 1.1). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Alford with the mode quality of Selker to minimize beam divergence and improve coupling of the radiation to optics, as well as reduce system losses.

Claims 56-57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Tsunekane.

With respect to claims 56-57, Alford teaches the OPS structure as outlined in the rejection to claim 53, but does not teach a birefringent filter to be located within the

resonator. Tsunekane teaches a folded cavity, pumped, 2^{nd} harmonic system wherein a birefringent filter is formed (col.1 lines 66-67). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Alford with the filter of Tsunekane in order to closely select a desired oscillation bandwidth, and suppress noise generation within the system (Tsunekane, col.2 lines 4-10).

Claim 72 is rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Mooradian (5131002).

With respect to claim 72, Alford teaches the method as outlined in the rejection to claim 70, but does not teach the use of a single axial mode. Mooradian teaches the radiation to be delivered via a single axial mode (col.4 lines 6-10). It would have been obvious to one of ordinary skill at the time of the invention to combine the method of Alford with the mode of operation of Mooradian for improved irradiating control of the target based on the use of the single Gaussian mode profile.

Claims 61 and 65 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Liu.

With respect to claims 61 and 65, Alford teaches the OPS structure as outlined in the rejection to claim 53, and further teaches the emission wavelength to be within 425-1800nm (pg.4 col.1 para.2, 980nm), and after frequency doubling between 212-900nm (980/2=490nm). Alford does not teach the resonator to be formed by at least two other

reflectors forming a resonator branch separate from the OPS structure, or the crystal to be located in the branch. Liu teaches a 3 mirrored laser resonator which utilizes an optical crystal to frequency double the output (abs., fig.1) located in a separate branch from the active medium. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the system of Alford with the extra mirror and crystal location of Liu in order to frequency double the output radiation and make use of wavelengths not previously attainable from the given active region, as well as to prevent 2nd harmonic radiation from entering the gain media, preventing losses.

Claims 62-63 and 66-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Liu and further in view of Mooradian.

With respect to claims 62-63, and 66-67, Alford and Liu teach the OPS system as outlined in the rejection to claims 61 and 65 above, but do not teach the use of a third additional mirror, which is formed of a second OPS structure. Mooradian teaches an OPS structure which has multiple mirrors, formed by the structures, and a high power output. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the system of Alford and Liu with an additional OPS reflector of Mooradian in order to generate higher output powers.

Claims 64 and 68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Liu, and further in view of Deacon (US 5206868).

With respect to claim 64, Alford and Liu teach the OPS structure as outlined in the rejection to claims 61 and 65, but do not teach the use of a second nonlinear crystal for frequency tripling, located in the branch segment. Deacon teaches a folded cavity system which uses and additional nonlinear crystal for frequency tripling (col.2 lines 40-43). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Alford and Liu with the additional nonlinear crystal of Deacon to convert to alternate multiple wavelengths for use in manufacturing, displays, etc., which was not possible to obtain from a single light emitter, as well as to locate the crystal in the branch segment to prevent 3rd harmonic radiation from entering the gain media, preventing losses (motivated by Liu's 2^{nd} harmonic crystal placement).

With respect to claim 68, Alford and Liu teach the OPS structure as outlined in the rejection to claims 61 and 65, but do not teach the use of a second nonlinear crystal for frequency tripling. Deacon teaches a folded cavity system which uses and additional nonlinear crystal for frequency tripling (col.2 lines 40-43). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Alford and Liu with the additional nonlinear crystal of Deacon to convert to alternate multiple wavelengths for use in manufacturing, displays, etc., which was not possible to obtain from a single light emitter.

Claims 73-74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Mooradian, and further in view of Kuznetsov et al. (M. Kuznetsov et al., 'High-power (>0.5-W CW) Diode-Pumped Vertical-External-cavity Surface-Emitting

Semiconductor Lasers with Circular TEM00 Beams" IEEE Photonics Technology Letters Vol. 9, No. 8, August 1997, pp. 1063-1065).

With respect to claims 73-74, Alford teaches the OPS structure as outlined in the rejection to claim 53, and further teaches the wavelength to be 980nm (pg.4 col.1 para.2, 980nm), and after frequency doubling between 212-900nm (980/2=490nm). Alford does not teach the OPS structure to have an output power greater than 5W or to have a plurality of transverse modes. Mooradian teaches a multiple OPS, and reflector (fig.1 mirrors #10, 26, 32, and 34), structure wherein it is taught that the outputs can be over 100W (col.1 lines 62-66). Kuznetsov teaches an OPS structure wherein multiple modes are taught to lead to increasing higher output powers (pg.3 col.1 para.2). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the single OPS structure of Alford with the multiple OPS and reflector structure of Mooradian, and the multiple modes of Kuznetsov in order to achieve high output powers usable in a multitude of industrial applications such as cutting or welding.

Claim 77 is rejected under 35 U.S.C. 103(a) as being unpatentable over Alford in view of Tsunekane, and further in view of Kuznetsov and Liu (US 4048515).

With respect to claim 77, Alford teaches the OPS structure as outlined in the rejection to claim 53, but does not teach the OPS structure to have a wavelength selective element, operate in multiple modes, or have a folded cavity containing the nonlinear crystal with an output mirror transmissive to the 2nd harmonic radiation and reflective to the fundamental. Tsunekane teaches a folded cavity, pumped, 2nd harmonic

system wherein a birefringent filter is formed (col.1 lines 66-67). Kuznetsov teaches an OPS structure wherein multiple modes are taught to lead to increasing higher output powers (pg.3 col.1 para.2). Liu teaches a folded cavity containing a nonlinear crystal (fig.1 #15) with an output mirror configured to be transmissive to 2nd harmonic light and reflective to the fundamental, including the use of line-narrowing when using the nonlinear crystal (col.4 lines 50-60, fig.2). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Alford with the filter of Tsunekane in order to closely select a desired oscillation bandwidth and suppress noise generation within the system (Tsunekane, col.2 lines 4-10), and the multiple modes of Kuznetsov in order to achieve high output powers usable in a multitude of industrial applications such as cutting or welding, and the folded cavity and output mirror of Liu to prevent 2nd harmonic radiation from entering the gain media, preventing losses, as well as the line narrowing to maximize 2nd harmonic power conversion (leading to the spectral range being properly aligned with the gain bandwidth).

Claims 78-79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu and further in view of Kuznetsov.

With respect to claims 78-79, Rosiewicz teaches the OPS structure as outlined in the rejection to claim 45, but does not teach the resonator to have first and second arms with a folded cavity containing a nonlinear crystal and an output mirror transmissive to 2nd harmonic light and reflective to fundamental, or to operate in multiple modes. Liu

teaches a two arm, folded cavity containing a nonlinear crystal (fig.1 #15) with an output mirror configured to be transmissive to 2nd harmonic light and reflective to the fundamental. Kuznetsov teaches an OPS structure wherein multiple modes are taught to lead to increasing higher output powers (pg.3 col.1 para.2). It would have been obvious to one of ordinary skill at the time of the invention to combine the OPS structure of Rosiewicz with the folded cavity and output mirror of Liu to prevent 2nd harmonic radiation from entering the gain media, preventing losses, as well as the use of the nonlinear crystal to generate alternate wavelengths, and additionally the multiple modes of Kuznetsov in order to achieve high output powers usable in a multitude of industrial applications such as cutting or welding.

Claim 80 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu and further in view of Tsunekane.

With respect to claim 80, Rosiewicz teaches the OPS structure as outlined in the rejection to claim 45, including a diode laser for the pump light (fig.1), as well as lens for focusing the pump light to the OPS structure (fig.1). Rosiewicz does not teach the use of a fold mirror or a folded cavity containing a nonlinear crystal and an output mirror transmissive to 2nd harmonic light and reflective to fundamental, or the use of a birefringent filter. Liu teaches a two arm, folded cavity containing a nonlinear crystal (fig.1 #15) with an output mirror configured to be transmissive to 2nd harmonic light and reflective to the fundamental. Tsunekane teaches a folded cavity, pumped, 2nd harmonic system wherein a birefringent filter is formed (col.1 lines 66-67). It would have been

obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz with the folded cavity and output mirror of Liu to prevent 2nd harmonic radiation from entering the gain media, preventing losses, as well as the use of the nonlinear crystal to generate alternate wavelengths, and additionally the use of the birefringent filter to closely select a desired oscillation bandwidth, and suppress noise generation within the system (Tsunekane, col.2 lines 4-10).

Claims 81-82 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu and further in view of Tsunekane and Holsinger (US 5892783).

With respect to claims 81-82, Rosiewicz, Liu, and Tsunekane teach the OPS structure as outlined in the rejection to claim 80, but do not teach the fold mirror to be curved, or the cavity length to be at least 5cm. Holsinger teaches a folded cavity system and nonlinear crystal wherein the cavity length is between 1m and 10cm (col.5 lines 49-54). Rosiewicz teaches the use of a curved output-coupling mirror (fig.1). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz, Liu, and Tsunekane with the cavity length of Holsinger to increase the number of axial modes and utilize a broader gain bandwidth (col.5 lines 49-58) for raising output power, and additionally use the curved mirror of Rosiewicz as the transmissive output coupling mirror to produce a round beam for more efficient power extraction (pg.1 col.2 para.2).

Claim 83 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu, Tsunekane and Shum (US 5848082).

With respect to claim 83, Rosiewicz, Liu, and Tsunekane teach the OPS structure as outlined in the rejection to claim 80, but do not teach the use of diamond between the heat sink and OPS structure. Shum teaches a heat sink for an optical system (abs.) using a diamond material mounted on top of a copper heat sink (col.5 line 57). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz, Liu, and Tsunekane with the diamond/copper heat sink of Shum in order to provide for low thermal resistance and good heat transfer characteristics (Shum, col.5 lines 58-59).

Claims 84-85 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu, Tsunekane, Shum, and Holsinger.

With respect to claims 84-85, Rosiewicz, Liu, Tsunekane, and Shum teach the OPS structure as outlined in the rejection to claim 83, but do not teach the use of multiple modes or a cavity length of at least 5cm. Holsinger teaches a folded cavity system and nonlinear crystal wherein the cavity length is between 1m and 10cm (col.5 lines 49-54). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz, Liu, Tsunekane, and Shum with the cavity length of Holsinger to increase the number of axial modes and utilize a broader gain bandwidth (col.5 lines 49-58) for raising output power.

Claim 86 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rosiewicz in view of Liu, Tsunekane, and Kuznetsov.

With respect to claim 86, Rosiewicz, Liu, and Tsunekane teach the OPS structure as outlined in the rejection to claim 80, but do not teach the use of multiple modes. Kuznetsov teaches an OPS structure wherein multiple modes are taught to lead to increasing higher output powers (pg.3 col.1 para.2). It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the OPS structure of Rosiewicz, Liu, and Tsunekane with the multiple modes of Kuznetsov in order to achieve high output powers usable in a multitude of industrial applications such as cutting or welding.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tod T. Van Roy whose telephone number is (571)272-8447. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Minsun Harvey can be reached on (571)272-1835. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TVR